Introduction

Between 1996 and 2002, nine major international ocean color satellite missions capable of providing routine global data will be in orbit. The NASA Sensor Intercomparison for Marine Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Program goal is to assist the international ocean color community in developing a multi-year time-series of calibrated radiances which transcends the spatial and temporal boundaries of individual missions.

SIMBIOS Science Team PIs (NRA-99)

180° 150°W 120°W 90°W 60°W 30°W 0° 30°E 60°E 90°E 120°E 150°E 180°

Project Organization

data processing.

• Pierre-Yves Dechamps

Christophe Menkes

Matt Pinkerton

Marcel Wernand

Figure 4

The Netherlands

Ispra (Varese), Italy

SIMBIOS Collaborations:

on *in situ* data

Laboratorie dÕOptique Atmospherique

(LOA), UniversiteÕ de Lille, France

et de Climatologie, Orstrom, France

Laboratoire de Physique et Chimie

Marines, Villefranche-sur-Mer, France

Natural Environment Research Council.

Plymouth Marine Laboratory, England

Netherlands Institute for Sea Research

Giuseppe Zibordi & Nicolas Hoepffner

Space Applications Institute, JRC

Laboratoire d'OcŽanographie Dynamique

The organizational approach includes the SIMBIOS Project Office at

the Goddard Space Flight Center (http://simbios.gsfc.nasa.gov) and the

SIMBIOS Science Team. The Science Team is selected through a

NASA Research Announcement (NRA, 1996 & 1999). The Project

funds numerous US investigators and collaborates with several

international investigators, space agencies (e.g., NASDA, CNES), and

international organizations (e.g., IOCCG, JRC) (Figures 3-4). US

investigators under contract provide in situ atmospheric and bio-

optical data sets, develop algorithms, on-orbit calibration evaluations,

and methodologies for data merger schemes. The locations of specific

The Project Office provides support and coordination for the

SIMBIOS Program such as administration, project documentation,

interagency and international coordination, and incorporates aspects of

instrument calibration, measurement protocol experiments, round

robins, algorithm development and evaluation, product merging, and

SIMBIOS Project has

Collaborations with:

⇒ GLI Science Team (NASDA)

Coordinating Group (IOCCG)

⇒ MODIS Science Team (NASA)

⇒ OCTS Science Team (NASDA)

⇒ POLDER Science Team (CNES)

⇒ SeaWiFS Science Team (NASA)

⇒ OCI Science Team (NSPO & SDDC)

⇒ International Ocean Color

SIMBIOS team investigations are shown in Figures 1 and 2.

International Collaboration (cont.)

Sensor Engineering & Calibration

• The Project has created a bio-optical "Instrument Pool" to

enhance the overall capabilities of the SIMBIOS Science Team,

and to provide backup in case of critical instrument failure during

an experiment. The bio-optical equipment in the Instrument Pool

are purchased and maintained by individual SIMBIOS principal

investigators, but deployment schedules and priorities are

coordinated by the Project Office with the advice of the Science

• To better support validation of algorithms for atmospheric

corrections and aerosol property retrievals, the SIMBIOS Project

Office has established a close working collaboration with the

Aerosol Network (AERONET) project, which maintains and

operates a worldwide network of sun-tracking photometers. The

NASA AERONET program is managed by GSFC personnel.

The Project Office has purchased equipment for 12 additional

island and coastal sun photometer stations to be added to the

AERONET system (Figure 12). In addition, the Project Office

maintains an "Instrument Pool" of several sun photometers,

which are calibrated by the GSFC AERONET investigators and

are made available to SIMBIOS investigators during field

• Round-Robin Activities: The SeaWiFS Transfer Radiometer

(SXR-II) is transported by a representative of the Project Office

to the laboratories whose personnel calibrate the field

radiometers used in SIMBIOS ocean optics validation

experiments. These laboratories include instrument

manufacturers, government laboratories, and academic

institutions who actively calibrate field radiometers used in the

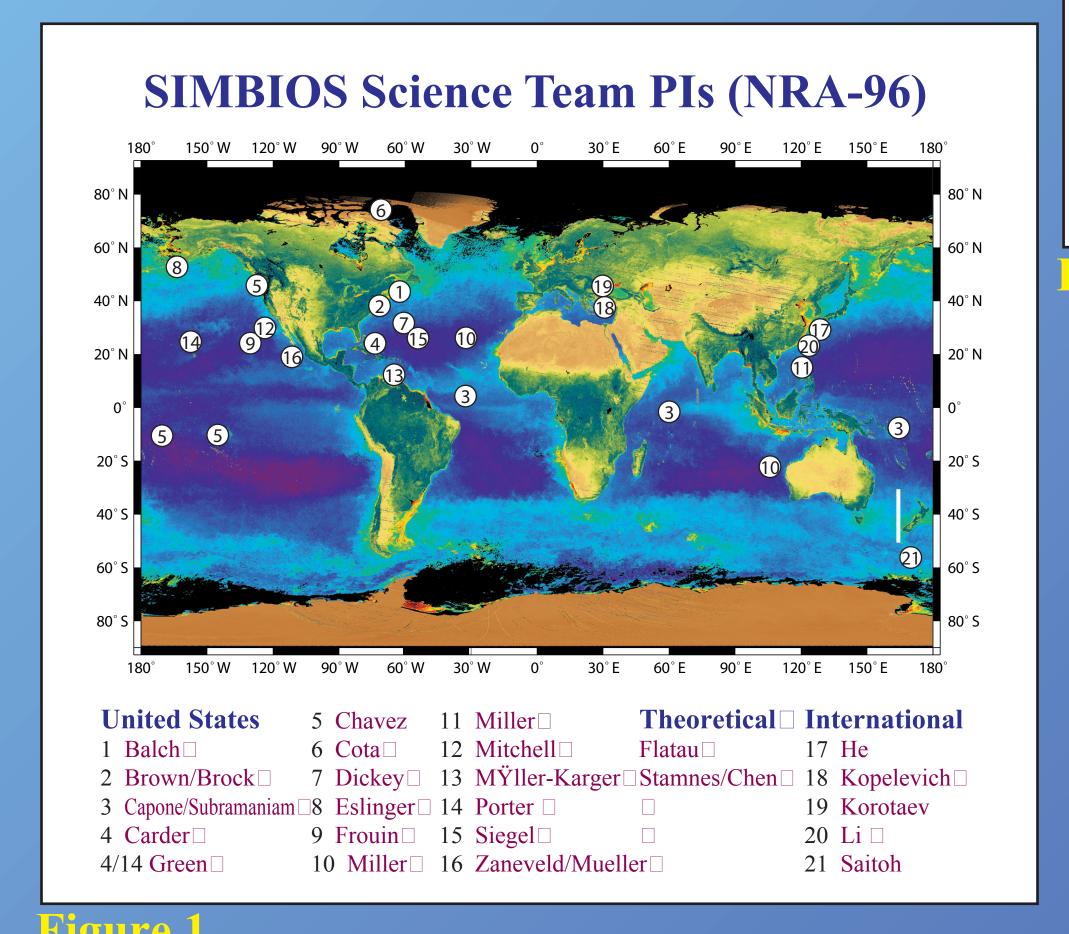
SIMBIOS program. The purpose of this comparison is to

determine the interlaboratory uncertainty in calibration sources

and procedures, and to detect and correct problems at any

individual laboratory in a timely fashion.

experiments (Figure 13).



International Collaboration 98-99

SIMBIOS Collaborations:

Marines, Villefranche-sur-Mer, France

School of High Technology for Human

on ocean color satellites

Laboratoire de Physique et Chimie

Welfare, Tokai University, Japan

Toulouse, CEDEX, France

& Harald Krawczyk (MOS)

Centre National dÕEtudes Spatialle,

Laboratorie dÕOptique Atmospherique

DLR Institute of Space Sensor Technology

& Planetary Exploration, Berlin, Germany

(LOA), UniversiteÕ de Lille, France

• Andreas Neumann, Gerhard Zimmermann

National Remote Sensing Agency

David Antoine

Hajime Fukushima

Jean-Marc Nicolas

SIMBIOS Science Team

- Ocean Remote Sensing Institute Ocean University of Qingdao, China • Gennady K. Korotaev
- Marine Hydrophysical Institute. National Ukrainian Academy of Science, Sevastopol, Ukraine • Oleg Victorovich Kopelevich Ocean Optics Laboratory
- Moscow, Russia • Hsien-Wen Li and Wei-Peng Tsai College of Science & Engineerin National Taiwan Ocean University
- Sei-ichi Saitoh and Ichio Asanuma Dept. of Fisheries, Oceanography, and Marine Sciences, Hokkaido University,

Bio-optical & Atmospheric Data Submitted to SeaBASS

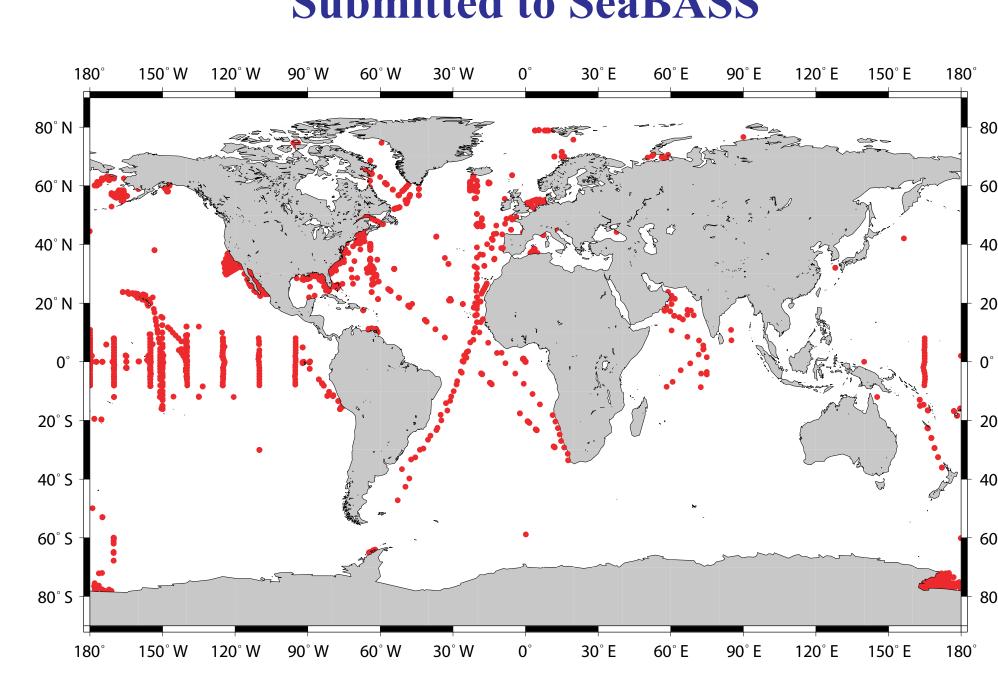


Figure 11

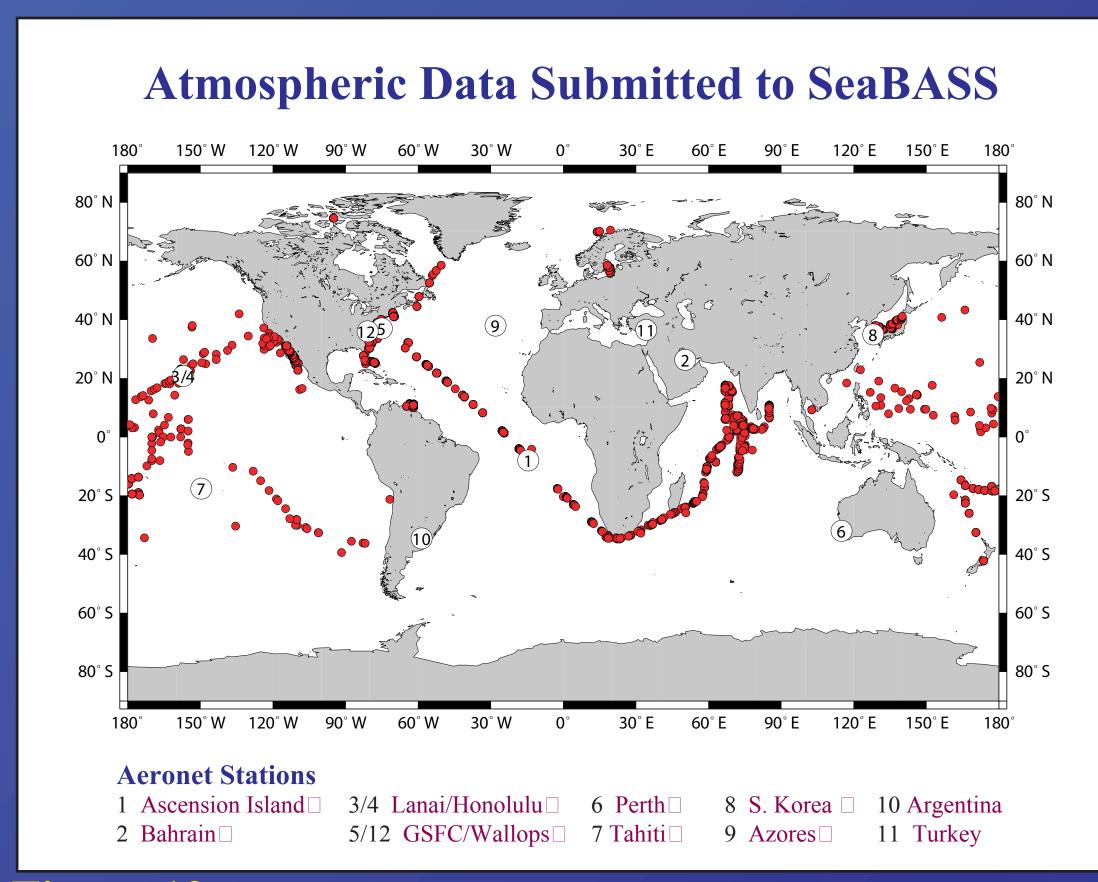


Figure 12

Ocean Color Instrument Intercomparison and Cross-calibration by the SIMBIOS Project (1999-2000)

¹Giulietta Fargion, ²Charles McClain, and ¹Robert Barnes

¹SAIC General Sciences Corporation, Beltsville, MD ²NASA Goddard Space Flight Center, Greenbelt, MD

http://simbios.gsfc.nasa.gov/



Figure 13

Satellite Data Processing

NASA

The data processing facility is operational and is scaled for limited data storage (in situ and satellite), product generation, and analysis support as required for SIMBIOS-specific investigations.

Data Product Validation

- The SIMBIOS calibration program reviews prelaunch and on-orbit calibration data available from the various satellite missions, to complement their activities with additional analyses or alternative approaches, and to provide an independent assessment of the data. At the present time, the SIMBIOS Project has actively worked on OCTS (Figures 7, 8, and 10), POLDER (Figure 9), MOS (Figure 6), and SeaWiFS data in collaboration with the respective space agencies and science teams.
- Validation is the process of determining the spatial and temporal error fields of a given biological or geophysical data product and includes the development of comparison or match-up data sets, i.e., field observations and satellite data coincident in time and location. The primary objective of the SIMBIOS Project is to identify biases between regions and between similar products generated by the various missions.
- SeaWiFS Ongoing Validation: aerosol optical thickness (AOT) products (Figure 14), validity of the suite of aerosol model currently used, derived products (e.g., chlorophyll), and match-up analysis (Figure 15)
- OCTS and MOS Validation: match-up comparison with field data completed
- POLDER Validation: match-up comparison with field data completed
- SIMBIOS collaborators who are associated with other NASA programs and science teams and who contribute data, algorithms, etc., are given access to SIMBIOS Project resources, e.g., the SeaWiFS Bio-optical Archive and Storage System (SeaBASS) worldwide archive of in situ measurements (Figure 11).
- The Project is presently providing SeaWiFS, MODIS, OCI, OCM, and MOS overflight predictions to help investigators in the field synchronize their optical data collection with the satellite overpasses. From October 1997 to April 2000, the Project has supported 179 cruises all over the world with more than 2800 SeaWiFS tailored images.

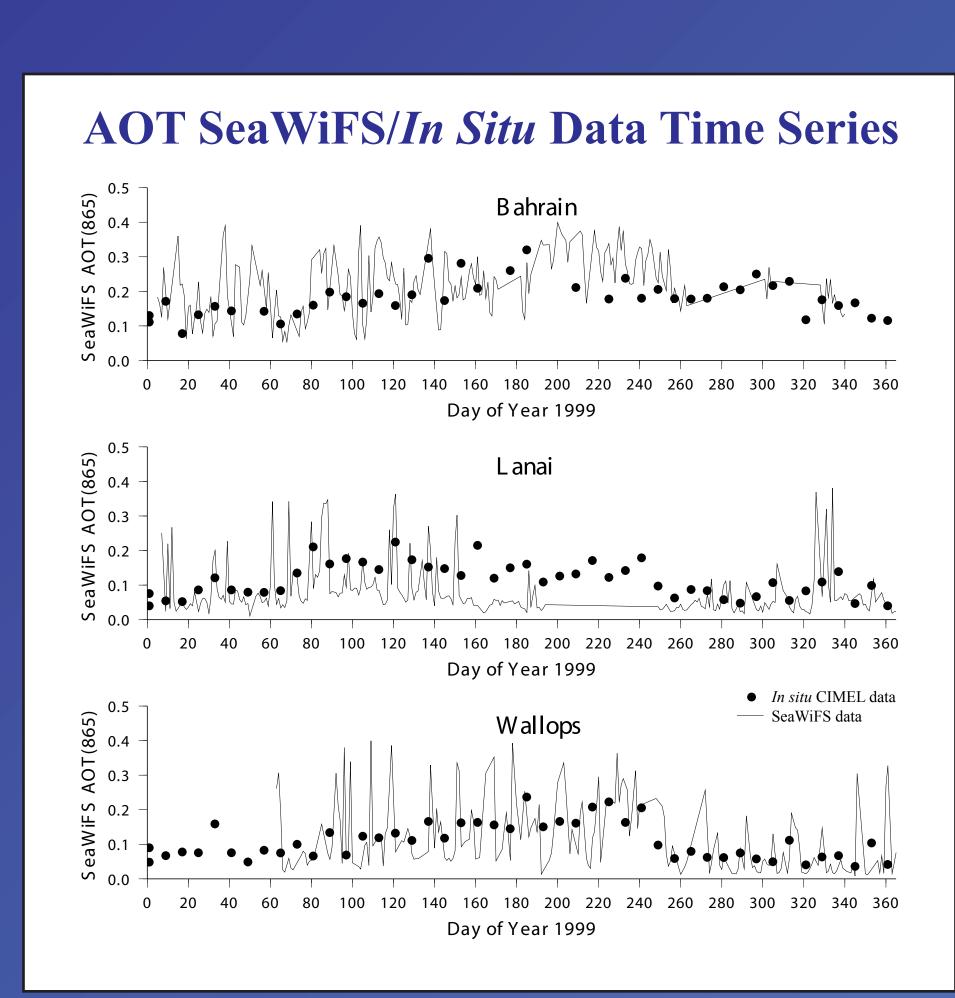


Figure 14

Program Objectives

Specific objectives are:

- (1) quantify the relative accuracies of the products from each
- (2) work with each project to improve the level of confidence and compatibility among the products,
- (3) develop methodologies for generating merged level-3 products.

Instruments

SIMBIOS has identified the primary instruments to be used for developing global data sets. These instruments are

- SeaWiFS
- OCTS
- POLDER (ADEOS-I and II)
- MODIS (Terra and Aqua)
- MISR
- MERIS

The products from other missions (e.g., OCI, OSMI, and the two MOS sensors) will be tracked and evaluated, but are not considered as key data sources for a combined global data set.

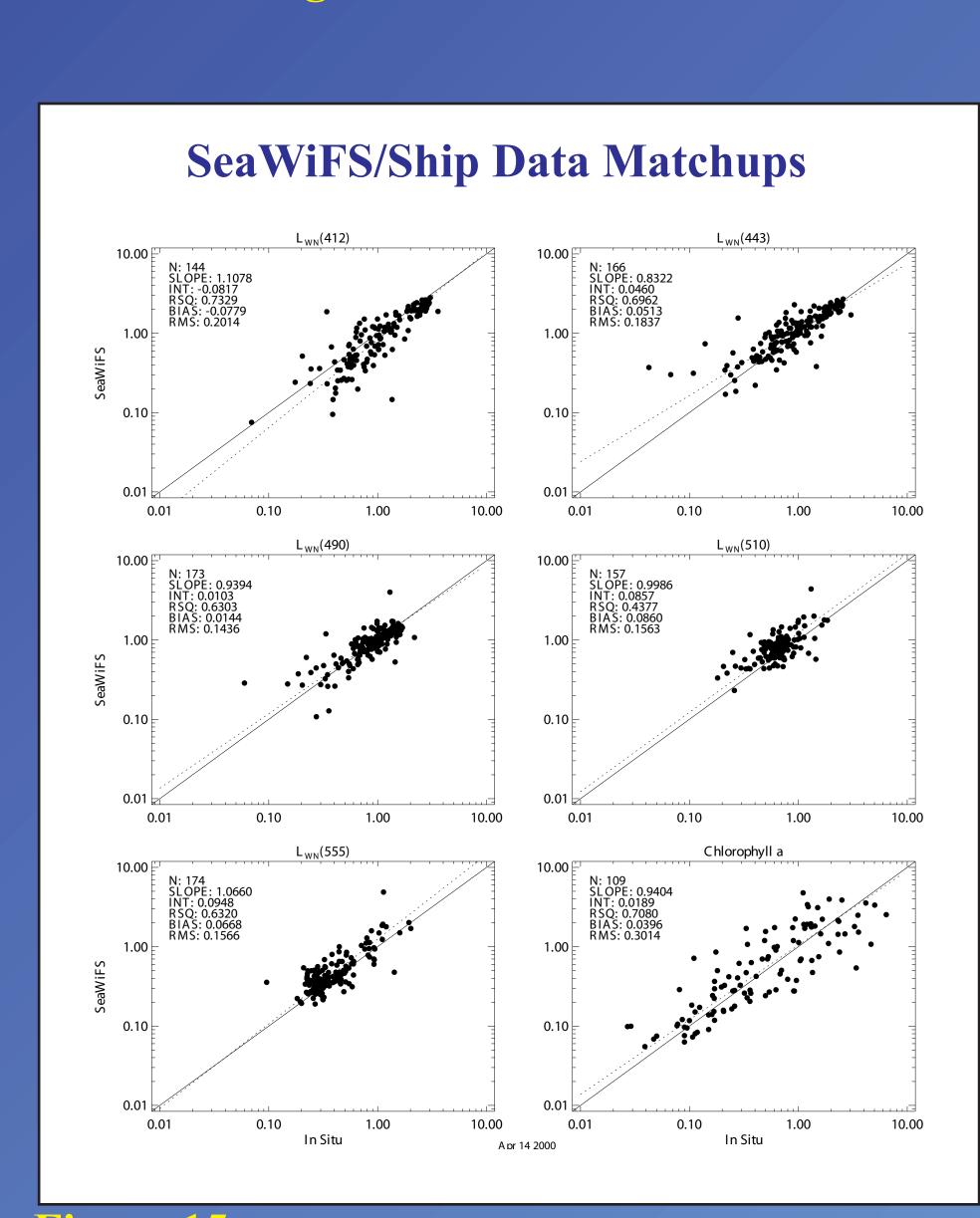


SeaWiFS-MOS Comparison SeaWiFS Atlantic Ocean Mediterranean Sea (28 Feb 1998)

 $[\rho_{\rm W}(2)]_{\rm N}(\%)$

Adriatic Sea

(24 Sept 1997)

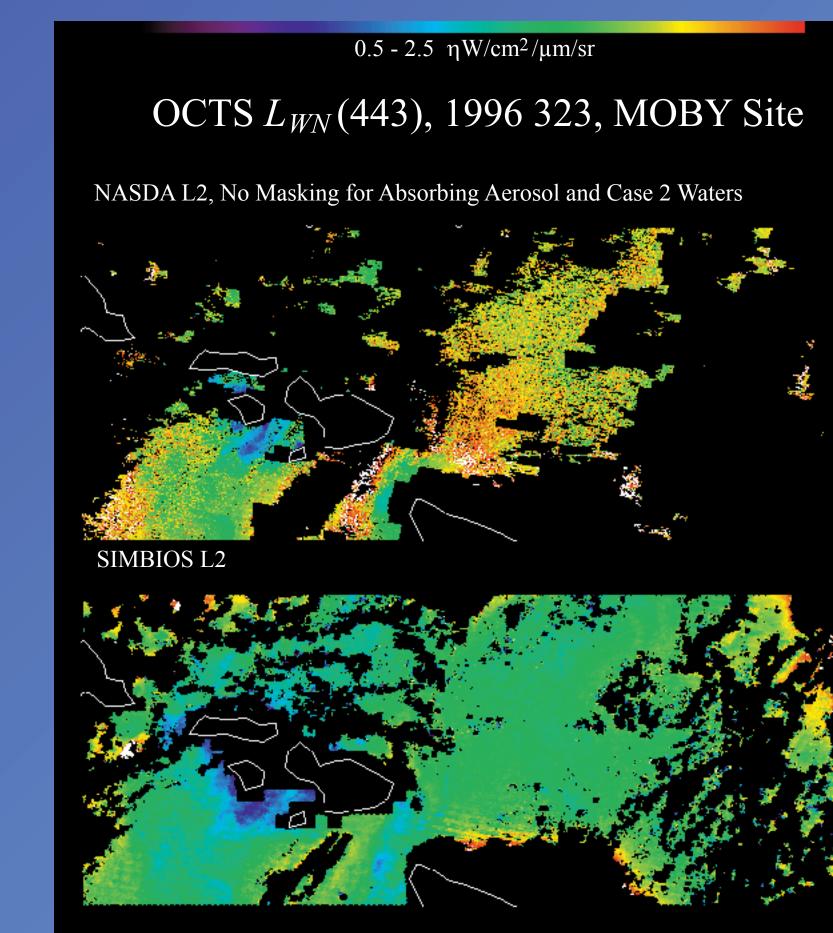


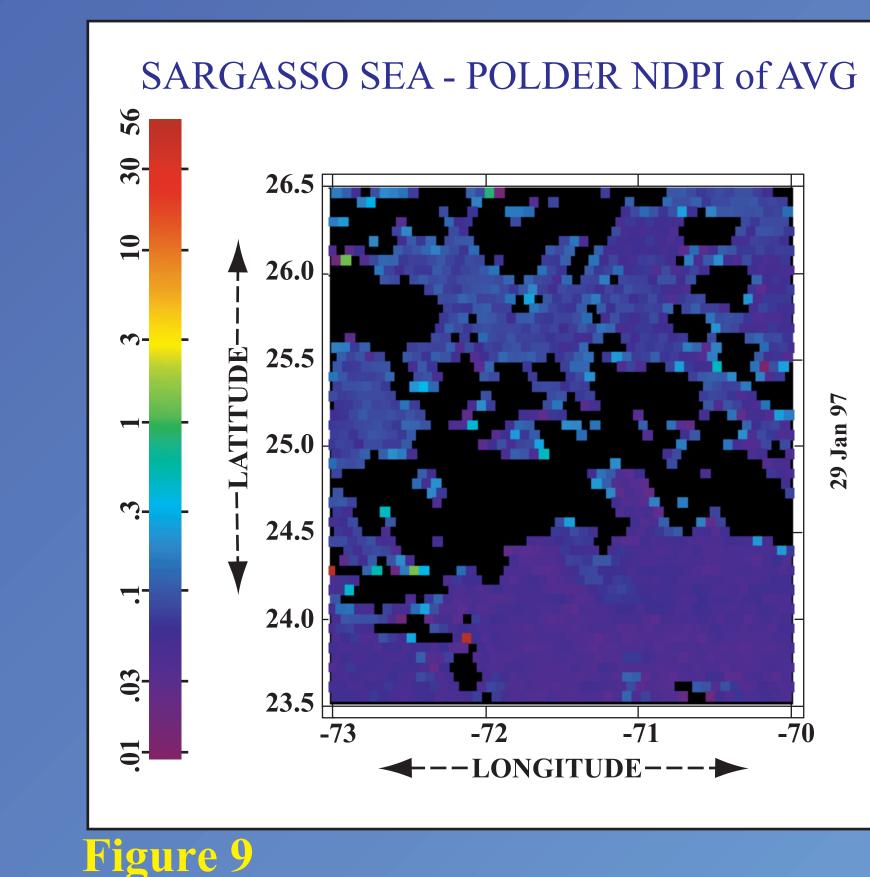
$4.5 - 7.5 \, \eta \text{W/cm}^2/\mu \text{m/sr}$ OCTS $L_t(490)$, 1996 323, MOBY Site

Figure 7

Data Merger

• The objective of the data merger component is to develop and test methods of combining data from different sources to provide time series of global fields (Figure 5). Sources may have different inherent spatial and temporal resolutions and different methods may be required depending on the geophysical quantity, e.g., chlorophyll a, waterleaving radiance, primary productivity, etc., which is being considered. Data merger algorithm development is the focus of two SIMBIOS Science Team investigations, both of which are in the phases of design and evaluation.





- Fargion, G.S., C.R. McClain, H. Fukushima, J.M. Nicolas. and R.A. Barnes, 1999: Ocean color instrument intercomparisons and cross-calibrations by the SIMBIOS Project, Sensors, Systems, and Next-Generation Satellites III, **3870**, 397-403.
- McClain, C.R. and G.S. Fargion, 1999a: SIMBIOS Project 1998 Annual Report, NASA Tech. Memo. 1999-208645, NASA Goddard Space Flight Center, Greenbelt, MD, 105 pp.
- McClain, C.R. and G.S. Fargion, 1999b: SIMBIOS Project 1999 Annual Report, NASA Tech. Memo. 1999-209486, NASA Goddard Space Flight Center, Greenbelt, MD, 128 pp.

